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WAGERING ON A LARGE SCALE: RELATIONSHIPS BETWEEN PUBLIC GAMBLING AND GAME MANIPULATIONS IN TWO STATE LOTTERIES

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Public wagering was examined in relation to game adjustments during the first 523 draws of Oregon's "Megabucks" lottery and the first 540 draws of Arizona's "The Pick" lottery. Oregon's lottery was modified five times during this period, and Arizona's lottery underwent four modifications. Public wagering was not related to decreases in the odds of winning in either state. Wagering increased in both states following the introduction of a minimum $1 million jackpot. Wagering also increased following a change in game frequency from weekly to semiweekly draws. Sales trends in both states suggest that over the period examined, larger jackpots were required to maintain previous levels of lottery play. These data suggest that public participation in gambling can be manipulated by state lottery commissions through adjustments in lottery contingencies.

DESCRIPTORS: wagering, state lotteries, game manipulations, naturalistic observation

Since their legalization in New Hampshire in 1964, large-scale state and multistate lotteries have been promoted to increase revenue to state treasuries. Over three fourths of the U.S. population now live in states that conduct legal lotteries or other games of chance. Sales of U.S. lottery products in 1988 totaled $14.9 billion, or over $100 per capita in lottery states, representing expenditures that exceeded the average household outlay for prescription drugs, medical supplies, or reading materials (Clotfelter & Cook, 1989).

Many states turn to legal gambling to partially offset declining state and federal funds for education, prison construction, and economic development programs. Although state gambling income is increasing, tax revenue is decreasing through public tax-limitation initiatives, thus fostering financial dependence on large-scale wagering. Oregon collected $90 million in lottery revenue from 1991 to 1993; with the addition of video poker, lottery income is projected to be $346 million for 1993 to 1995. In the same period, an Oregon property tax reduction measure is expected to produce a $1.2 billion state deficit, requiring significant budget cuts for all state and local agencies, including public education. To at least one political reporter, Oregon lottery income has become "a key part of everyone's political strategy" that is "growing like a stack of chips in front of a craps player on a hot streak" (Mapes, 1993, p. C9). Arizona lottery revenues similarly increased from $59 million in 1983 through 1984 to $230.5 million in 1990 through 1991. In light of the proliferation of state-sponsored gambling, it appears that other states also find lotteries fiscally attractive.

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These state and multistate lotteries offer unique opportunities to behavior analysts interested in the behavior of large groups of people. Ticket sales represent the betting of thousands of people wagering millions of dollars. Which variables influence public participation in large-scale lotteries? Students of behavior look to the player, the game, and the social context for information. To those who conduct the state gambling business, the most important variables are the factors that can be manipulated to increase ticket sales on a large-scale basis.

If lottery officials turn to the psychological literature, they find that most published works from cognitive psychology and economics have focused on the strategies that gamblers appear to follow when choosing between probabilistic alternatives, such as those described by normative decision theory, normative utility theory, or heuristics and biases (see Wagenaar, 1988). In general, cognitive theories assume that individuals make "rational" decisions by choosing alternatives that maximize total utility. Most published behavioral studies on gambling have focused on the act of choosing between alternatives, given different environmental constraints such as reinforcement probability, reinforcement delay, or feedback about reinforcement. In general, these theories assume that individuals act "rationally" either by distributing choices according to relative reinforcement value (matching) or by choosing alternatives that maximize total reinforcement value (Rachlin, 1989).

Certain human activities, however, appear to be irrational: We purchase insurance against unlikely events, drive our automobiles in ways that make accidents more likely, and spend money buying lottery tickets with infinitesimal odds of winning (Herrnstein, 1990b). To explain such discrepancies, most choice and decision theories posit that we discount the probabilities and values of events with time. Behavioral studies have examined such discount functions in hypothetical human wagering (e.g., Rachlin, Raineri, & Cross, 1991), and animal operant analogues have demonstrated that pigeons can be induced to behave "irrationally" by manipulating the structure of the "game" (e.g., Kendall, 1987).

Very little gambling research has involved humans wagering or winning significant sums of money. Typically, subjects are asked to respond to hypothetical gambling situations with hypothetical wagers or to controlled gambling conditions involving small amounts (less than $20) of legal currency (e.g., Heath & Tversky, 1990; Rachlin et al., 1991; Wagenaar, 1988). In the rare studies that have examined realistic gambling situations, player strategies usually remain the variable of interest (e.g., Halpern & Devereaux, 1989; Keren & Wagenaar, 1985; Metzger, 1985).

The gambling strategy that a player follows is a variable of interest to both behavior analysts and lottery officials, but it is not easily manipulated on a large scale to increase lottery participation (assuming that the game is fair and its promotion is factual). The characteristics of the game itself (game rules, cost per play, draw schedule, jackpot size) also affect the activity of players. These are the variables that are directly manipulated by gaming boards and state commissions to encourage high levels of public participation and state profit. Games offered by states differ in terms of odds of winning (lotteries have the lowest odds), cost of play (several games cost $1 per ticket, whereas casino-based games can involve a much higher risk), and size of jackpots (ranging from one free play to over $100 million in some lottery drawings).

Obvious legal and ethical constraints limit direct experimental manipulation of game variables in large lotteries. Experiments in the psychology laboratory cannot ethically allow subjects to lose large sums of money, nor can they realistically pay subjects multimillion dollar prizes; moreover, state-sponsored games of chance are conducted under the public's trust and legal mandate that winners are selected fairly, by random drawing. Thus, researchers must select between studies involving large-scale gambling in the natural setting (which are essen-

tially correlational investigations) and laboratory analogues of gambling (which may have limited applicability to true wagering). Whereas laboratory research allows experimental manipulation of game variables, naturalistic studies have the advantage of directly observing the behavior of gamblers while they are influenced by actual betting circumstances rather than by laboratory analogue conditions, and while they receive actual financial consequences rather than hypothetical accumulated tokens.

Although researchers cannot ethically or practically manipulate game variables in lotteries, state gaming commissions occasionally do. Since their introduction in the mid-1980s, the large-scale lottery games offered by Arizona (The Pick) and Oregon (Megabucks) have undergone occasional modifications in order to maintain or increase game popularity. In some cases, changes in one state's game were replicated in the other state: Both Arizona and Oregon have decreased the odds of winning jackpots by increasing the field of numbers from which play is selected. Both states have established minimum jackpots of $1 million, and have switched to semiweekly (Wednesday and Saturday) games rather than retaining a once-per-week (Saturday) draw.

The present study explored the relationships between various game manipulations and levels of public wagering across several years of lottery play in Arizona and Oregon. Extensions from cognitive and behavioral models of choice, extrapolated from Rachlin (1989), allow some general predictions about the effects of these game manipulations:

1. Lowering the odds of winning should result in reduced wagering, because the average utility of a gamble, expressed as probability times amount of outcome, declines in comparison to the cost of play, and because the probability of reinforcement declines.

2. Increasing the jackpot size should result in increased wagering, because the average utility of a gamble compared to the cost of play increases, and because reinforcement magnitude increases.

3. Offering games more frequently should increase wagering, because risk aversion decreases with repeated gambles, and because opportunity to respond for reinforcement increases.

METHOD

Dollars wagered was examined in relation to five game adjustments in the Oregon lottery and four game modifications in the Arizona lottery during the first 523 Oregon draws and 540 Arizona draws. Sales and jackpot listings in dollars per draw were obtained from state lottery commission offices in Arizona and Oregon. To control for inflationary effects, actual dollar figures were adjusted according to the monthly historical Consumer Price Index (CPI) averaged for U.S. cities (base 1982–1984 = 100).

As in all naturalistic observation studies, these correlational data are limited to describing the strength and direction of the relationship between wagering and game manipulations, without the benefits of experimental controls. However, because the sequence of game modifications was similar for both Arizona and Oregon and the timing of these modifications was staggered, the data allowed assessment in the form of a quasi-experimental natural multiple-baseline design across states. The specific game adjustments for each state are described below.

Oregon

The Oregon Megabucks game began in November 1985, as a weekly (Saturday) draw with a variable, cumulative jackpot that was claimed by correctly picking six numbers from a field of 38 (odds of winning the jackpot with a single pick were 1 in 2,276,681; $1 buys two picks). By August 1991, the game had been modified five times:

1. After 28 weeks of operation (in June 1986), odds of winning the jackpot were decreased by requiring players to correctly pick six of 42 numbers (odds, 1 in 5,245,786).

2. After 44 weeks of operation (in September 1986), the minimum jackpot for correctly picking all six numbers was set at $1 million.

3. Semiweekly draws (Wednesday and Saturday) began in June 1987.

4. In May 1989 (after 271 draws in the Megabucks game), the odds of winning the jackpot were again decreased by requiring players to correctly pick six of 44 numbers (odds, 1 in 7,059,052).

5. Beginning in August 1990, two game modifications were added: First, "Investor's Choice" requires the bettor to specify the jackpot payment schedule (one lump payment of the entire jackpot or payout as a 20-year annuity). Second, for an additional $1 wager, "Power Play" makes smaller prizes (e.g., $200 to $700) available for matching three, rather than four, numbers.

Arizona

The Arizona lottery's large-scale lotto game (The Pick) began in October 1984, as a weekly (Saturday) draw with a variable, cumulative jackpot that was claimed by correctly picking six numbers from a field of 36 (odds of winning the jackpot with a single pick were 1 in 1,947,792; $1 buys one pick). By September 1991, it had undergone four game adjustments:

1. After 2 years of play (beginning in October 1986), the odds of winning the jackpot were decreased by requiring players to correctly pick six of 39 numbers (odds, 1 in 3,262,623). At this same time, a "bonus" number was added, increasing the number of prize divisions from three to four: The second-place prize could be claimed by picking five of six winning numbers and matching the bonus number.

2. Shortly thereafter (January 1987), the minimum jackpot for The Pick was set at $1 million.

3. After 186 weeks of play (in May 1988), the game began semiweekly (Wednesday and Saturday) draws.

4. Finally, in July 1989, the odds of winning the jackpot were again decreased by requiring players to correctly pick six of 42 numbers (odds, 1 in 5,245,786).

RESULTS

Figure 1 shows wagers per week and game changes across 363 weeks (540 draws) of the Arizona lottery between 1984 to 1991 and 301 weeks (523 draws) of the Oregon lottery between 1985 and 1991, displayed as a natural multiple baseline across states (all dollar figures are CPI adjusted). Early in the Arizona game's history, wagers totaling nearly $6 million in Week 45 of 1985 were associated with a jackpot of $8 million; the highest levels of betting in Weeks 5 and 6 of 1990 occurred in connection with a jackpot that grew to over $18 million: Arizona Wagers × Jackpot, Pearson $r = .85$, $t(538) = 38.10$, $p < .001$. In Oregon, high levels of wagering in Weeks 13 and 14 of 1988 were associated with a jackpot that eventually climbed to $12 million, and large total wagers in Weeks 29 to 31 of 1991 accompanied a jackpot that reached nearly $17 million before being claimed: Oregon Wagers × Jackpot, Pearson $r = .80$, $t(521) = 30.24$, $p < .001$.

The relationship between wagering and jackpot size is summarized for both states in Figure 2. As jackpot size increased, wagering increased as well (bin sizes for jackpots over $6 million have been expanded to include sufficient observations for averaging). Within each jackpot bin size, wagers tended to build across consecutive games until the jackpot was claimed, then fell in the game immediately following a win (the jackpot reset after any successful claim).

Visual inspection of Figure 1 suggests that decreasing the odds of winning had little impact on wagering in either state, whereas jackpot manipulations and game frequency changes were associated with increased wagering in both states. Quantitative assessment of these game manipulations, using one-tailed dependent t tests, compared wagering immediately preceding and following each game adjustment. (Because only 15 games occurred between Oregon's

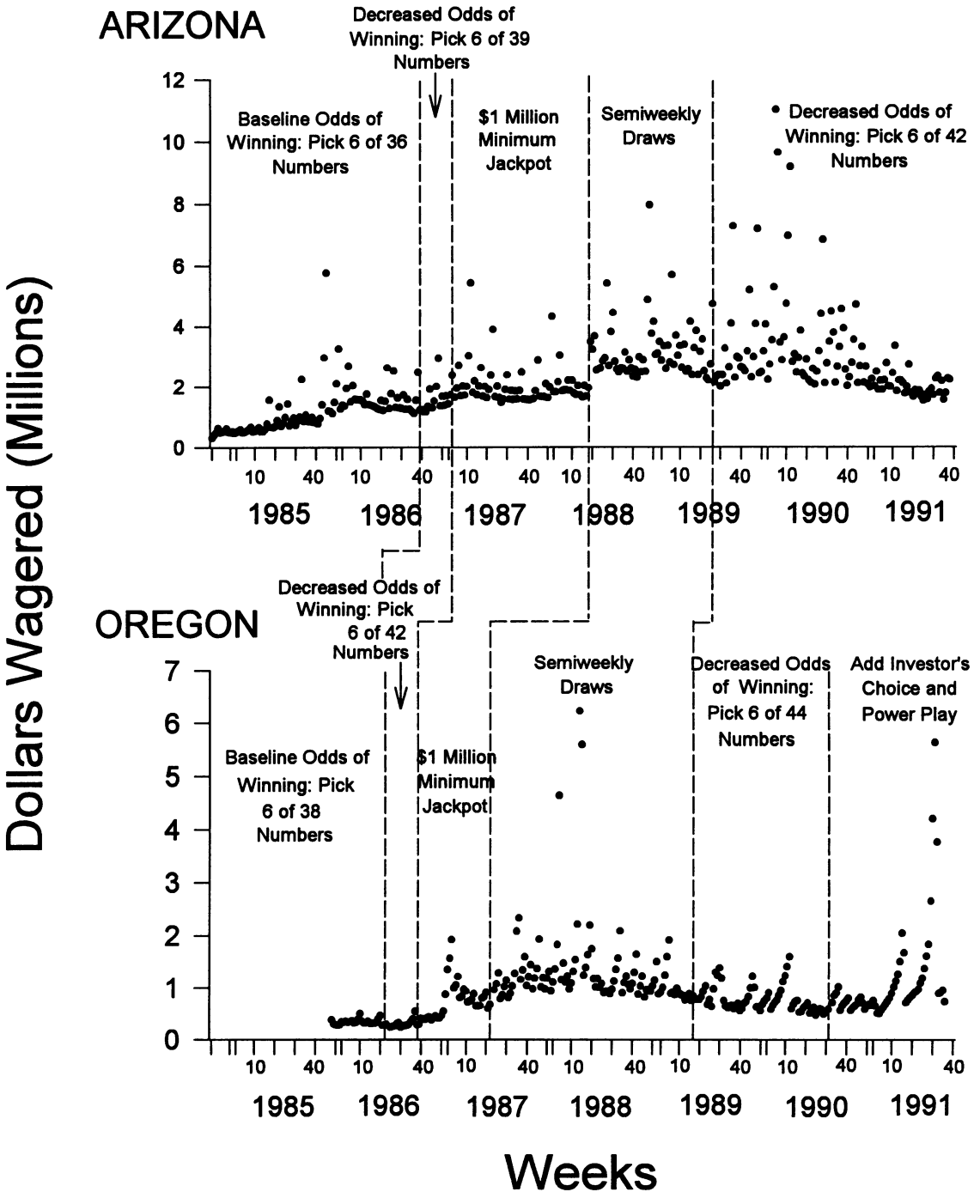

Figure 1. Weekly sales totals for Arizona's The Pick lottery, October 1984 through September 1991, and Oregon's Megabucks lottery, November 1985 through September 1991.

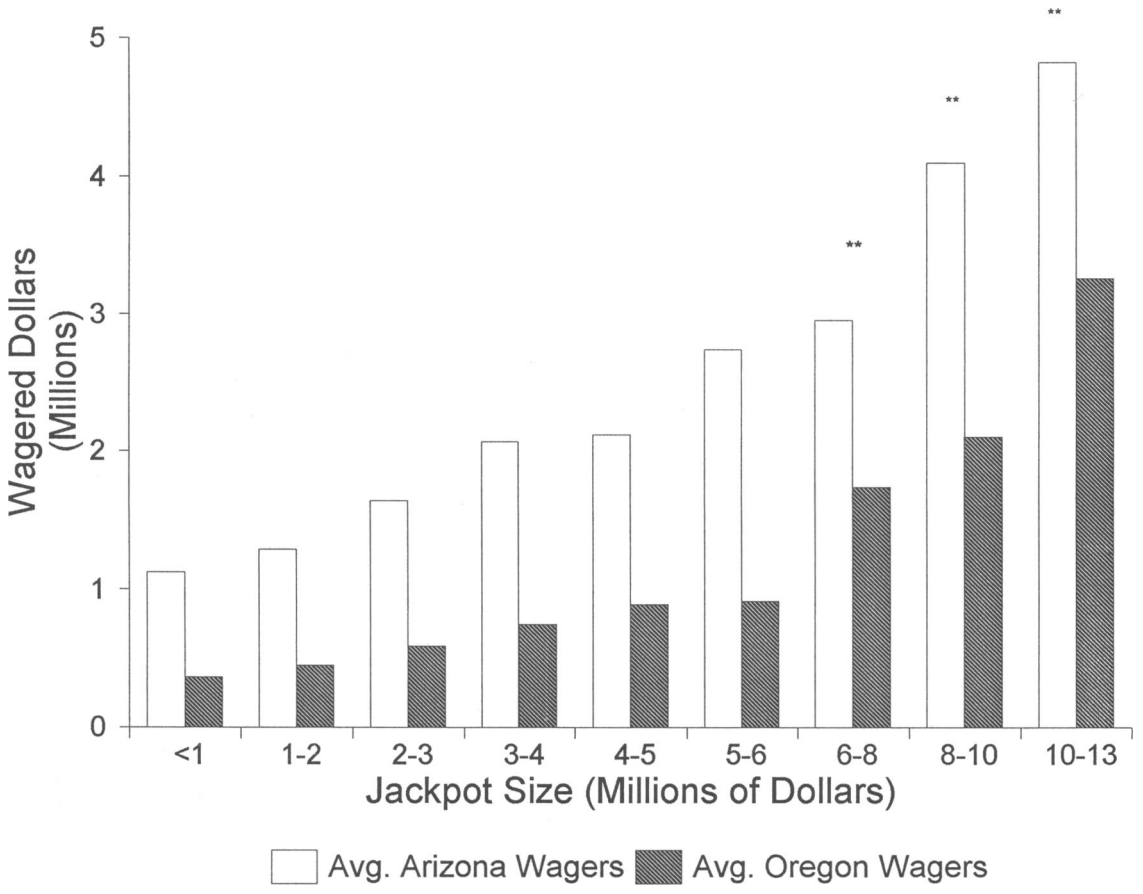

Figure 2. Average wagers as a function of various jackpot levels in Oregon and Arizona. **Jackpot bin size expanded due to limited observations.

first and second game modifications, all other before-and-after comparisons are based on 15-draw periods as well.) Game modifications are considered in greater detail below.

Odds Manipulations

The first odds change in Oregon occurred in June 1986, when players were required to match six of 42 numbers rather than six of 38 (more than doubling the odds against claiming the jackpot to 1 in 5.2 million). Wagers, averaged across the draws preceding and following the manipulation, did not change significantly, $t(14) = 1.42$, $p = .09$. The second Oregon odds adjustment took effect in May 1989, when players were required to match six of 44 numbers. Again, no significant change in wagering followed in the next 15 draws, $t(14) = 1.55$, $p = .07$.

Arizona first extended game odds in The Pick's 104th weekly draw, in October 1986. Players were required to match six of 39 numbers rather than six of 36, decreasing the odds of claiming the jackpot to 1 in 3.2 million. Average wagers did not change significantly across the next 15 draws, $t(14) = 1.01$, $p = .16$. The second Arizona odds change occurred in July 1989, when players were required to match six of 42 numbers against odds of 1 in 5.2 million. Immediately before the change took place, a jackpot that had grown to an announced value of nearly $6 million was claimed on July 1; the jackpot was reset as the new odds took effect. As a result, average wagers in the 15-draw pe-

riod prior to the odds change were significantly higher than in the period following the manipulation, $t(14) = 1.98$, $p = .03$. If the comparison is extended to 20 draws, the periods do not differ significantly in average wagers, $t(19) = .01$, $p = .49$, indicating that the difference was not part of a trend of reduced wagering.

Jackpot Manipulations

Wagers and jackpots for the 15 draws preceding and following the establishment of a $1 million minimum jackpot in both states are displayed in Figure 3. In Oregon, wagers increased significantly, $t(14) = 3.06$, $p = .004$, following jackpot manipulation. Similarly, Arizona recorded increased wagering after setting a $1 million minimum jackpot, $t(14) = 2.19$, $p = .02$.

The drawing power of a $1 million jackpot declined over time in both states, however. Average wagers associated with announced jackpots of $1 million can be examined in terms of the ratio of CPI-adjusted sales to CPI-adjusted jackpot values: a sales:jackpot ratio of 1.0 indicates that a jackpot of $1 million dollars drew wagers of $1 million, whereas a sales:jackpot ratio of 0.5 indicates that a jackpot of $1 million drew wagers of $500,000. From 1987 to 1990, the average sales:jackpot ratios for $1 million games in Arizona were 1.86, 1.42, 1.40, and 1.35, respectively; average sales:jackpot ratios in Oregon for the same years were 0.61, 0.52, 0.41, and 0.32.

Game Frequency Manipulations

Oregon changed from weekly Saturday games to semiweekly (Wednesday and Saturday) games in June 1987; Arizona began semiweekly games in May 1988. When average wagers over the 15 weeks before the game frequency manipulation are compared with those of the same period after semiweekly games began, weekly wagers increased significantly in Arizona, $t(14) = 5.55$, $p < .001$, and Oregon, $t(14) = 5.24$, $p < .001$. Saturday sales consistently outpaced Wednesday sales in Arizona, $t(176) = 2.81$, $p < .003$, and in Oregon, $t(221) = 3.37$, $p < .001$, throughout the remaining observations. The differences between Wednesday and Saturday sales in the two states were not the product of differences in respective jackpot size: Average Wednesday and Saturday jackpots did not differ significantly in either state: for Arizona, $t(176) = 1.00$, $p = .16$; for Oregon, $t(221) = 0.06$, $p = .47$. No other monthly, seasonal, or annual patterns were apparent in the data.

DISCUSSION

These comparisons suggest that wagering in large-scale lotteries in Arizona and Oregon was not influenced by decreases in the odds of winning a large jackpot, even when game manipulations lowered the chances of winning by more than two thirds. At the same time, cross-state comparisons show that increasing game frequency and manipulating jackpot size by establishing a minimum $1 million jackpot were related to increased public wagering.

The relationship between jackpot size and ticket sales is a strong one, and it is bidirectional: Larger jackpots drive more betting, and increased betting produces larger jackpots (which accumulate until a claim is successful). Declining sales:jackpot ratios in both states show that the drawing power of any particular jackpot in these games is not constant, however. Against an inflation-adjusted prize of $1 million, sales have fallen in both states, although the lottery remains profitable in both states because jackpots go unclaimed in the majority of games (only 89 jackpots were claimed in Oregon's 533 games, and 201 jackpots were claimed in Arizona's 540 games). In fact, sales curves in games with $1 million jackpots resemble gradual extinction curves from individual subjects. (Baum, 1974, has also noted that group behavior may resemble individual behavior, but see Johnston & Pennypacker, 1993.) A contrast effect might be operating: In the context of larger jackpots, the resetting of a $1 million jackpot may seem like a steeper drop. One implication

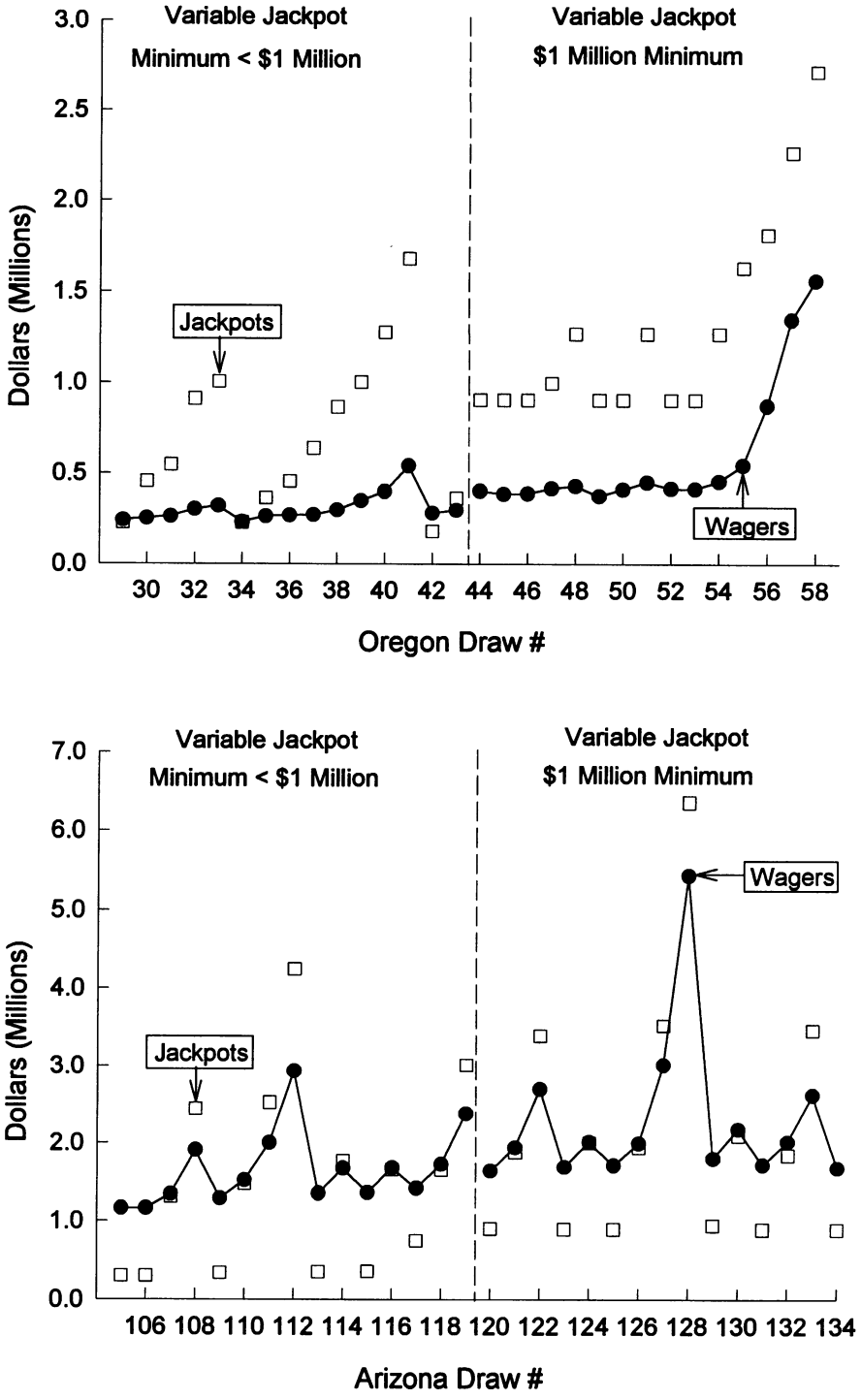

Figure 3. Sales and jackpots per draw in Oregon Megabucks games (upper panel) and Arizona The Pick games (lower panel) for the 15 draws immediately preceding and following the establishment of a $1 million jackpot.

of this decline—that setting larger minimum jackpots might allow states to maintain current levels of play—also suggests that spiraling prize magnitude will outstrip state resources, leading to larger multistate or national lotteries with the population base to support such massive payouts. Already, California's lottery has a $5 million minimum jackpot, and the multistate Lotto America game set a $2 million jackpot minimum in 1989.

The Wednesday and Saturday sales patterns that occurred in both states following introduction of semiweekly draws were not related to jackpot size but rather to temporal characteristics of the game. Wednesday and Saturday jackpots did not differ in either state, but more wagers were placed on Saturday games than on Wednesday games in both states. The betting "window" favors Wednesday games, because tickets for these draws were available 4 days per week, rather than the 3-day Saturday window. Presumably, players were more likely to encounter an opportunity to play Saturday games; in both Arizona and Oregon, most lottery outlets are stationed in grocery stores and convenience markets.

Players' relative insensitivity to odds changes in both Arizona and Oregon suggests that states can gradually decrease chances of winning to increase state income if jackpot size remains large and games are offered frequently. People tend to act as if they overestimate very low probabilities and underestimate high-probability outcomes (Herrnstein, 1990b). Possibly, players do not discriminate the odds changes as they take effect, because publicity about these changes is typically minimal (although players are confronted with a modified game ticket or computer screen of numbers from which to pick). It is also possible that, through marketing campaigns and publicity about winners of large jackpots, states partially maintain play through verbal means. Advertising presents rules (e.g., "you can't win if you don't play" or "some lucky dog's gonna win it!") along with words and pictures depicting attractive consequences of play. These may serve as establishing operations (Michael, 1993) that function to increase the relative frequency of ticket purchases, regardless of the odds of winning. Thus, some aspects of lottery play may be rule governed rather than contingency managed.

Rachlin (1990) has suggested that continued wagering after losing can be considered as a series of events in time; the relevant unit is not an individual game and its outcome but rather the length of a string of losses that eventually culminate in a win. In this view, the delay to an outcome is important: "the gambler's accounting system is such that wins and losses are added up only after a win (at the end of each string); then the system is reset" (p. 295). Because any win would more than eliminate all losses, players of large-scale lotteries may tolerate indefinite reinforcement delay (losing) in light of reinforcement magnitude. When the initial risk is so small and the potential gain so large, individual losses have little significance.

Lottery play is frequently presented as an example of human behavior that is not "rational," in the sense that the average player never receives financial reinforcement for playing. Rational choice theories, derived through formalistic or deductive approaches, assume that individuals fundamentally act to maximize subjective utility; these theories seem to predict that people will not engage in lottery play at all (Herrnstein, 1990a, 1990b; Rachlin, 1989). To the extent that people do play, rational choice theories predict that the Oregon and Arizona jackpot manipulations and game frequency changes would invite increased wagering, because the expected utility of play is improved and risk aversion is reduced with repeated gambles. If one considers the expected utility of a lottery wager (odds of winning times jackpot value), some games do produce an average expected utility above the cost of a ticket, and these gambles would not necessarily be "irrational" according to economic theory. Average expected utility exceeded the $1 ticket cost in only 13.2% of games in Oregon (69 of 523

draws) and only 12.6% of games in Arizona (68 of 540 draws). Across all odds levels and jackpots, average expected utility in Oregon games (with two number picks per ticket) was \$0.65 and in Arizona games (with one number pick per ticket) was \$0.54. Thus, public participation in these lotteries continued in spite of negative average expected utility.

Behavioral theories of choice, unlike rational choice theories, are derived from more naturalistic or inductive approaches (Herrnstein, 1990a). These theories attempt to account for observed choice as a function of input from the environment, and can generally be considered to be theories of reward following, whether presented as matching, melioration, or optimization theories (Staddon, 1991). By modifying contingencies, organisms can be induced to choose alternatives that are "self-defeating" in the context of other alternatives (e.g., Kendall, 1987). Behavioral choice theories predict that both jackpot manipulation and game frequency manipulations will increase wagering, based on decades of experimental work involving the effects of reinforcement magnitude and reinforcement frequency.

The apparent insensitivity to decreased odds of winning might not be easily predicted by either type of choice theory. As noted earlier, gambling research is usually conducted in analogue settings or by asking subjects to imagine choice situations. There are compelling reasons to study actual gambling situations rather than arrangements of hypothetical contingencies. Thought experiments from the laboratory may have limited generality to actual financial contingencies (see Rachlin, 1989, for a summary of research concerning the dangers of extrapolating from laboratory gambling to the real world). Skinner (1985) criticized the methodology of cognitive psychology precisely because of the practice of "substituting descriptions of settings for the settings themselves" (p. 301). In the present study, observation of wagers before and after odds manipulations produced data that may conflict with theories based on hypothetical wagering.

Several methodological limitations restrict the applicability of these findings to any choice theory. Theories of choice are theories of individual behavior (see Herrnstein, 1990a) rather than group behavior (as measured by total wagers on a statewide level). Correlational data are measures of relationships rather than directions of influence. Naturalistic observations are conducted under uncontrolled conditions and are subject to numerous confounding effects. In addition, we investigated only one product of the state gambling industry. To its Megabucks lottery, Oregon has added instant scratch-off numbers games, keno, video poker, and betting on professional sports, as well as the multistate Lotto America game. Arizona began with instant scratch games, then added The Pick, various other instant games, and Fantasy 5 (top prize \$50,000). Both states border Nevada, whose public gaming preceded the other state lotteries, and California, whose minimum lottery jackpot is \$5 million. Other states bordering Oregon and Arizona now offer competing games of chance as well. Interactions among the lotteries considered here and these other competing games, as well as the social and economic contexts in which they are offered, probably affect participation in both Megabucks and The Pick to some extent.

Still, these data suggest that public participation in large-scale lotteries may be a function of game contingencies. It appears that states have found a renewable financial resource too valuable to ignore, and governments are increasingly turning to legalized betting to support state budgets. By manipulating game structure, state lottery officials may have the means to keep this resource renewable.

REFERENCES

Baum, W. M. (1974). Choice in free-ranging wild pigeons. *Science, 185,* 78–79.

Clotfelter, C. T., & Cook, P. J. (1989). *Selling hope: State*

lotteries in America. Cambridge, MA: Harvard University Press.

Halpern, A. R., & Devereaux, S. D. (1989). Lucky numbers: Choice strategies in the Pennsylvania daily number game. *Bulletin of the Psychonomic Society, 27,* 167–170.

Heath, C., & Tversky, A. (1990). Preference and belief: Ambiguity and competence in choice under uncertainty. In K. Borcherding, O. Larichev, & D. Messick (Eds.), *Contemporary issues in decision making* (pp. 93–123). Amsterdam: North-Holland Elsevier Science Publishers B.V.

Herrnstein, R. J. (1990a). Behavior, reinforcement, and utility. *Psychological Science, 1,* 217–224.

Herrnstein, R. J. (1990b). Rational choice theory: Necessary but not sufficient. *American Psychologist, 46,* 356–376.

Johnston, J. M., & Pennypacker, H. S. (1993). *Strategies and tactics of behavioral research* (2nd ed.). Hillsdale, NJ: Erlbaum.

Kendall, S. B. (1987). An animal analogue of gambling. *The Psychological Record, 37,* 247–256.

Keren, G., & Wagenaar, W. (1985). On the psychology of playing blackjack: Normative and descriptive considerations with implications for decision theory. *Journal of Experimental Psychology: General, 114,* 133–158.

Mapes, J. (1993, April 18). Salem eager to dip into fat lottery pot. *The Sunday Oregonian,* p. C9.

Metzger, M. A. (1985). Biases in betting: An application of laboratory findings. *Psychological Reports, 56,* 883–888.

Michael, J. (1993). Establishing operations. *The Behavior Analyst, 16,* 191–206.

Rachlin, H. (1989). *Judgment, decision, and choice: A cognitive/behavioral synthesis.* New York: Freeman.

Rachlin, H. (1990). Why do people gamble and keep gambling despite heavy losses? *Psychological Science, 1,* 294–297.

Rachlin, H., Raineri, A., & Cross, D. (1991). Subjective probability and delay. *Journal of the Experimental Analysis of Behavior, 55,* 233–244.

Skinner, B. F. (1985). Cognitive science and behaviorism. *British Journal of Psychology, 76,* 291–301.

Staddon, J. E. R. (1991). Selective choice: A Commentary on Herrnstein (1990). *American Psychologist, 46,* 793–797.

Wagenaar, W. A. (1988). *Paradoxes of gambling behaviour.* Hove and London: Erlbaum.

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